Fire Safety Challenges of Insulation Materials and Systems

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Context

- The push to ‘green’ buildings is growing. This can include reducing building materials, adding insulation, and installing alternative energy sources. However, the extent to which such green building elements and features may increase fire risks or hazards, or decrease building safety performance, has not been systematically studied.

Context

- A recent study supported by the Fire Protection Research Foundation (FPRF) look at fire incidents, ‘green; systems and materials and related fire performance research.

http://www.nfpa.org/assets/files//Research%20Foundation/RFFireSafetyGreenBuildings.pdf

Context

- 80 Green Building Elements / Attributes
  - Structural Materials and Systems (9)
  - Exterior Materials and Systems (13)
  - Façade Attributes (4)
  - Interior Materials and Finishes (9)
  - Interior Space Attributes (10)
  - Building Systems & Issues (12)
  - Alternative Energy Systems (9)
  - Site Issues (14)

Context

- 22 Fire Risk / Hazard Attributes
  - Presents a potential hazard
    - E.g., ignition, electrical shock, explosion, toxicity
  - Hazard attributes
    - E.g., readily ignitable, burns readily once ignited, contributes more fuel / increased HRR, etc.
  - Failure potential
    - E.g., shorter time to failure, failure affects burning characteristics or smoke spread or…
  - May impact building FP system or feature
    - E.g., smoke/heat venting, suppression effectiveness, apparatus access, firefighter access & operations…

Potential Concerns

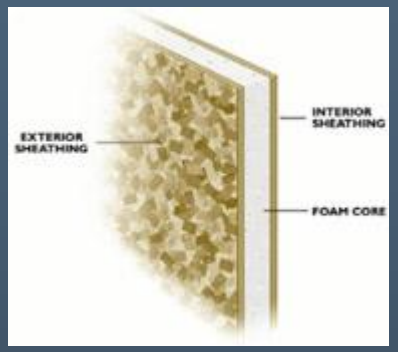
- Reduced and/or natural material vs. reduced strength or fire protection
  - Lightweight engineered lumber
  - High strength concrete
  - Combustible interior finishes

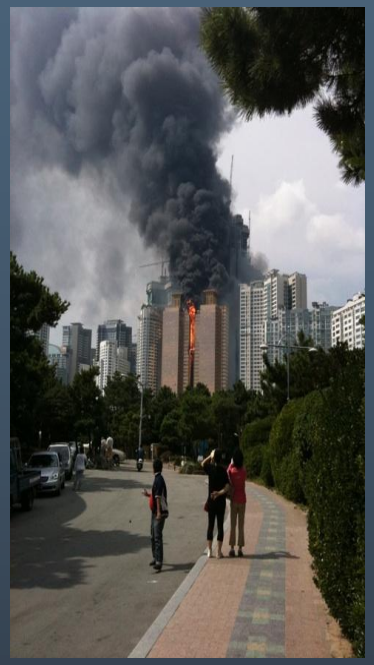
http://www.ul.com/global/eng/pages/offerings/industries/buildingmaterials/fire/fireservice/lightweight/

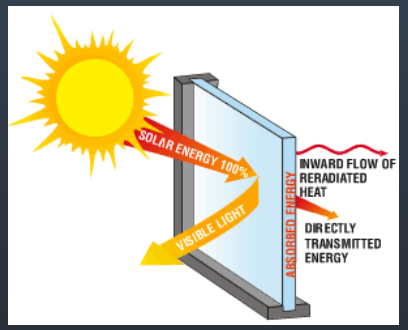
Courtesy MSU

Potential Concerns

- Material properties
  - High thermal insulation vs. flammability
    - New materials as interior lining, façade, insulation, within sandwich panel and more – increased fuel load, distribution, flame spread, smoke spread…
    - High thermal insulation vs. effect on compartment temperatures in a fire
    - Sudden glazing failure and modified burning environment







Potential Concerns

- Material properties
  - Toxicity (IAQ) vs. fire retardant qualities
    - Chemical additives in foam insulation and other materials – toxicity under fire and non-fire conditions?
      - Polystyrene foam insulation used in building insulation (both XPS, such as Styrofoam, and EPS) is treated with hexabromocyclododecane, (HBCD), a persistent, bioaccumulating, and toxic fire retardant

http://www.hoffmaninsulation.com/Products.html

http://www.noburn.com/intumescent-paints-fire-retardant-coatings

Potential Concerns

- PV panels: FF access, ignition, and fire spread

Potential Concerns

- Combination of high density housing, LEL systems, combustible insulation, smaller streets, water conservation, …

Potential Concerns

- Insulation challenges
  - Foam insulation (spray applied, rigid) can be combustible if not treated with some type of fire retardant
  - Certain fire retardants have potential health implications (e.g., HBCD)
  - Thermal barriers can help keep potential sources of ignition from insulation, but provide limited or no protection if damaged or missing
  - How address the ‘risk-risk’ trade-off’?

Potential Concerns

This site contains videos of simulations of the Station Night Club fire, and the NIST report with recommendations pertaining to foam insulation.

http://www.nist.gov/fire/stationfire.cfm

Potential Concerns

NIST Video – Fire Involving Non FR PU Foam (Station Nightclub)
http://www.youtube.com/watch?v=IxiOXZ55hbc

Potential Concerns

- Combustible siding and insulation

- http://www.youtube.com/watch?v=K8pGUULE3Xc&feature=player_embedded

http://ulfirefightersafety.com/category/projects/study-of-residential-attic-fire-mitigation-tactics-and-exterior-fire-spread-hazards-on-fire-fighter-safety/

Potential Concerns

- Combustible exterior insulated panel systems
  - http://www.youtube.com/watch?v=0yQLIIletDM

http://www.fireengineering.com/articles/2010/05/modern-building-materials-are-factors-in-atlantic-city-fires.html

Potential Concerns

- Recent fires with combination PV and combustible insulation on roof decks

http://abclocal.go.com/wpvi/gallery?section=news/local&id=9226626&photo=1

Potential Concerns

- Recent fires with combination PV and combustible insulation on roof decks

Courtesy of NJ State Fire Marshal Office

Courtesy of National Fire Protection Association

Potential Concerns

- What happens with combination of high density housing, LEL systems, combustible insulation, PV panels, smaller streets, …

Fire Mitigation Strategies

- Non-combustible insulation
- Non-toxic FR insulation
- Durable and complete thermal barriers
- Separation of potential sources of ignition from combustible materials
- Additional protection, such as automatic fire sprinklers
- New technologies (formulations, coatings,…)

Needs

- Better data on combination of thermal and fire performance (sustainability and safety)
- Better data on health effects versus fire impact (chronic versus acute)
- Better understanding of, and approaches to, ‘risk-risk’ tradeoffs (if necessary) for policy and practice
- Better regulatory approaches to assure safety along with sustainability

Future Activities

- New study underway to look at some of these issues, including residential wall systems (LEL and insulation, SIPs, modular systems, etc.) supported by DHS/FEMA/USFA Assistance to Firefighters Grant program, award EMW-2012-FP-01336, *Quantification of Green Building Features on Firefighter Safety*

(http://www.wpi.edu/academics/fpe/quanti75.html)

Thank You!

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